December 7, 2005

Ms. Nancy Reimer
Donovan Hatem LLP
Two Seaport Lane
Boston MA 02210

Re: Analysis of Flywheel Housing Failures

Dear Ms. Reimer:

This letter serves as my report into the failure of the flywheel housings experienced by Trans-Spec Truck Service, Inc.

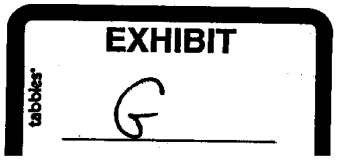
1. Background

During the period from late 1999 to early 2000, Tran-Spec took delivery of 22 Sterling trucks that were powered with Caterpillar C-12 engines. Trans-Spec had previously owned trucks that had been powered with Caterpillar 3176 engines. These vehicles were used primarily for the delivery of heating oil in the New England area.

The C-12 engines were delivered by Caterpillar with an aluminum flywheel housing that was intended to support the engine and the transmission. Although the trucks were built by Sterling, it is my understanding that Caterpillar approved the overall design of the truck and warrantied the C-12 engine system for 60 months/500,000 miles.

The flywheel housing is connected to the engine with twelve M12, 10.9 grade, bolts and to the transmission with 12 substantially smaller diameter bolts. The housing is aligned with the block by means of two dowels. The flywheel housing was also connected to the vehicle frame by means of two engine mounts.

Soon after delivery the flywheel housings started failing. These failures were characterized by the loosening of the bolts that connected the engine to the flywheel housing. The failures were also characterized by cracks developing in certain locations



of the flywheel housing, severed bolts and dowels, deformed and damaged bolt holes, and wear patterns at the bottom of the housing. When a flywheel housing failed on the C-12 engine, the truck would necessarily have to be taken off the road for a costly and extended repair.

The engines as designed, manufactured, and sold by Caterpillar were defective by reason of this design flaw and normal usage would render the engines and trucks unusable. These engines were covered by the Caterpillar extended warranty which obligated Caterpillar to repair the engine components, where feasible, or to replace the engines or defective components. Caterpillar refused to honor the warranty.

2. Inspection of the flywheel housings

I have inspected several flywheel housings that showed various degrees of failure:

(a) Flywheel Housings at Altran. It is my understanding that two housings were removed from Trans-Spec vehicles because they had failed and were transferred to Altran in Boston for evaluation. One of these came from a C-12 engine and the other from a 3176 engine. Both showed significant cracks and damage to the bolt holes that connect the flywheel housing to the engine. Both housings also showed significant wear to the lower regions that face the oil pan and oil pan gasket. It is my understanding that Dr. Thomas Service will be submitting a detailed report on these two housings.

(b) Flywheel Housings at Trans-Spec. I inspected two flywheel housings that were still installed on two disabled trucks that had been in rollover accidents. There were no visible signs of cracking or other signs of failure to either housing. One of the housings was removed at my request. I inspected this housing after it was cleaned. It still showed no discernable damage despite the fact that it had been in a serious accident.

(c) Flywheel Housings at Caterpillar. On November 29, 2005, when I visited the Caterpillar facility at 1201 N. University in Peoria, Illinois, I was able to visually inspect 7 flywheel housings. It was my understanding that these housings had been removed from Trans-Spec trucks when they had failed. Figures 1-7 (see Appendix) show a representative collection of pictures that were taken under my direction by an independent photographer during my visit.

Fig. 1A shows the first housing that I inspected on November 29 at Caterpillar. Figs. B, D, and E show two large cracks that are in the lower left hand (when observing the housing from the engine side) corner of the housing.

Figure 1C shows a deformation of one of the bolt holes. This type of deformation was seen to various degrees in many of the holes of the failed housings that I inspected, both in Boston and Peoria. This failure is characterized by threadlike ridges that were cut into the much softer aluminum by the M12 bolt threads. These holes were designed to be through holes and are not intentionally threaded.

Fig. 2A shows the second housing that was inspected. This housing shows a limited amount of wear in the lower part of the housing that faces the oil pan. This should not be occurring in this location since this is not a mating surface. Fig. 2B shows one of the bolt holes that has sustained limited damage from the bolt. It should be noted that there should be a clearance of ½ mm between each of the 12 bolts and the respective bolt hole wall. So in a properly functioning housing, the bolt threads should not touch the inner surface of the bolt hole.

Figs. 2C and 2D show a large crack in the vicinity of the housing as in the housing in Fig. 1. As in the previous housing, this crack intersects one of the bolt holes.

Fig. 3A shows the third housing that was inspected in Peoria. As can be observed, the housing has extensive road dirt, oil, and grime which obscure large sections of the housing. It was not possible to remove all this during the inspection. I was able to clean a small portion near the lower left hand bolt hole and observed a similar crack to those in Figs. 1 and 2. This crack is shown in Figs. 3B and C. Fig. 3D shows damage to the region where the housing is attached to the truck body with an engine mount. Fig. 3E again shows damage to a bolt hole.

Fig. 4 shows the extensive damage of the flywheel housing. Fig. 4B shows a sheared bolt and badly deformed dowel hole in the lower left hand corner of the housing. Fig. 4C shows more sheared bolts and damage to the inner lip of the housing. The aluminum appears to have softened and flowed in this region. Fig. 4D shows a badly damaged bolt hole. In addition to the threads being cut into the sides, the lip has been fractured. Fig. 4F shows the heads of two of the M12 bolts that were sheared. The bolt heads are discolored and show significant abrasion. Fig. 4E again shows damage to the region where the housing is attached to the truck body with an engine mount. Fig. 4G shows the flywheel side of the housing. No cracks could be observed either on the inside or outside surface of the housing. Also, despite the extensive damage to the bolts and dowels between the transmission and the engine, little or no damage could be observed to the surface and bolt holes that attach the flywheel housing to the clutch housing and the transmission.

The flywheel housing in Fig. 5 also had no visible cracks, but did show damage to bolt holes and the engine mount area. The housing in Fig. 6 shows very similar damage

to the housing shown in Fig. 5, except that this housing has a significant crack in the lower left hand area.

There were no visible cracks in the housing shown in Fig. 7, although limited bolt hole damage was observed. However, this housing was unpainted and showed no signs of having ever been painted. It is my understanding that Trans-Spec never used an unpainted housing so it is unlikely that this housing was from Trans-Spec.

3. Conclusions

My inspection of these housings, showed that the bolted interface between the Caterpillar C-12 engine and the Caterpillar housing had failed. Repair/warranty records of the Trans-Spec trucks show the flywheel housing failed repeatedly on all of the vehicles. The frequency of these failures is unacceptable.

Information made available by Caterpillar as a part of the litigation showed that housing failures occurred on the Caterpillar C-12 engines with other OEM's and customers. They also occurred on the Caterpillar C10 engines that have a similar aluminum flywheel housing. As mentioned earlier in this report, I personally observed housing from a 3176 engine.

The frequency of the housing failures in the Trans-Spec C-12 engines, and the fact that similar housings failed in other engine models and for other customers, indicates that there was a problem with the housing used on the C-12 engines.

Documents disclosed in this case indicate that the Trans-Spec C-12 engines were used within their specifications in the Sterling truck. In fact, internal Caterpillar emails indicate the possibility was considered by Caterpillar that the Trans-Spec engines were failing because they were being used improperly or outside their specs. These documents

also indicate that Caterpillar concluded, based on its own analysis, that the engines were being used within specifications.

One possible source of the problem that is specifically considered by Caterpillar is the weight of the Meritor transmission model RMX10-165C that bolts to the opposite side of the housing from the engine. Caterpillar specifically indicates in its own documents that it considered this issue and came to the conclusion that the weight of the Meritor transmission and attached PTO's were not the cause of the flywheel housing failures.

My own conclusion, based on my own analysis, indicates that the use of the Meritor transmission was not only pre-approved by Caterpllar when the vehicles were ordered, but that they were within spec. Furthermore, it is noteworthy that the interface between the flywheel housing and the transmission did not fail in any of the cases that I investigated where the housing/engine interface failed. This is a strong indicator that the problem is not the transmission.

The documents also show that an additional support was added to the transmission by Trans-Spec as recommended by Caterpillar for heavier transmissions, although such support was not indicated by the specs for the Meritor transmissions. However, my discussion with Trans-Spec personnel and Caterpillar internal documentation indicated that this additional support did not solve the cause problem.

In July 2004, Caterpillar tested one of the Trans-Spec trucks on a dynamometer to determine if vibrations due to the powertrain were within limits. The vehicle was driven at various speeds.

Mr. Bowes, in his deposition (pp. 233-234) says that the test results indicate that the engine in the Trans-Spec vehicle is a "perfectly normal operating engine." However, the vibration sensors in this test would have picked up much more than just the vibration from the engine. They would have picked up vibration from the other components of the drivetrain, including the transmission. So the positive results of this test are a demonstration that the drivetrain as a whole was functioning properly.

I understand from a conversation with Trans-Spec service technician, Mr. Abel LaFlash, that the first indication of a problem was frequently that certain bolts, typically the lower bolts, that attached the Caterpillar housing to the Caterpillar engine would start loosening.

Based on my review of documents in this case, my own analysis and my conversations with Trans-Spec personnel, I have come to the conclusion that failure of flywheel housings were caused by a design flaw and not because of any deficiencies in the way the C-12 engines were installed or used by Trans-Spec or others.

It is clear from the documents that certain individuals at Caterpillar agreed with this conclusion. In fact, it is my understanding that Caterpillar, at least initially, agreed with this conclusion because it replaced failed housings under warranty.

4. Cause of the problem

Based on the information available, to a reasonable degree of scientific certainty, the failures of the housings were caused by a design flaw. The flywheel housings in question are made of aluminum.

To my knowledge, Caterpillar design documents for this housing were not made available, so it is not possible to determine whether Caterpillar considered thermal loads

and stresses in their design process. Specifically, there are no documents that I have observed that show this issue was considered during the design process.

What is clear, however, is that Caterpillar knew the aluminum flywheel housings were problematic. For example, in its U.S. patent number 6,065,757, a Caterpillar patent filed July 12, 1998, entitled Flywheel Housing, the inventors disclosed to the U.S. patent office that:

"Engineers are designing flywheel housings that are lighter weight and less costly. Over the years engineers have discovered that weight and cost reductions are achieved by manufacturing flywheel housings out of aluminum. During normal operation of an engine, cyclic temperature changes can cause thermal expansion and contraction of various components at varying rates. The use of components made of different materials adds to the relative movement between thermal expansion greater than the thermal expansion of a cylinder block causing relative movement between the flywheel housing and the cylinder block. The relative movement between the flywheel housing and the cylinder block, if not absorbed by a seal positioned between the two components, can cause the flywheel housing or seal to leak, crack or can destroy connecting bolts used for connecting the flywheel housing to the cylinder block." (Col. 1, lines 10-36)

The inventors further explained that their improved housing would tolerate ". . . thermal stresses, operating vibration, and harsh environment that are normally present during engine operation ." (col. 3, lines 29-32.)

During the prosecution of their application, in an amendment dated 11-22-99, the inventors argued that their improvement was novel because the prior art aluminum flywheel housings suffered from "greater thermal stresses, operating vibration, and harsh environment." (Page 8 of Amendment)

This patent application was filed prior to the delivery of the engines to Trans-Spec. The flywheel housing in the C-12 engines was made of aluminum. The improvement disclosed in the Caterpillar patent was not incorporated. At least some of

the problems disclosed in the patent as being symptomatic of aluminum housings were observed in the Trans-Spec engines.

I also understand that Caterpillar also supplied engines to the Department of Defense through Stewart & Stevenson. At least some of these engines that had aluminum flywheel housing failed due to cracking. I understand Caterpillar remedied this problem by replacing the aluminum flywheel housing with a cast iron housing.

In his deposition, Mr. Bowes indicates that when a new housing is designed, Caterpillar typically uses a finite element model of the housing and then applies loads according to "these" accelerations. (page 63, lines 18-22).

In my opinion, this is lacking and deficient for a number of reasons. First, thermal stresses are ignored. As was clearly indicated by the inventors of US patent 6,065,757, thermal stress is key and can cause "bolts to break." The significantly higher expansion coefficient of aluminum compared to steel will cause increased stresses in both the axial and radial directions. Temperatures in the areas of the flywheel housing will rise as the engine reaches operating temperature because of the proximity of the hot oil pan and the exhaust system. Also, several of the flywheel housings have shown a significant amount of wear in the region that faces the oil pan. This wear would significantly increase the temperature of the housing compared to the engine block, exacerbating the thermal stresses. Secondly, the approach ignores stresses due to engine torque which can also significantly increase the loads on the bolted interface.

Regardless of whether Caterpillar considered thermal loads during the design of C-12 engine and its flywheel housing, I have seen no indication that Caterpillar considered this issue after failures were observed.

Caterpillar made no effort to consider this issue in the only finite element analysis of the C-12 flywheel housing that I have observed. I have seen no data of tests run on vehicles in actual use that even attempted to measure temperature or strains and stresses in the flywheel housings.

I consider the failure analysis of this problem that I have observed by Caterpillar to be inadequate.

5. Summary of Conclusions

1. Aluminum flywheel housing supplied by and warrantied by Caterpillar to Trans-Spec failed.
2. Caterpillar had observed such failure in other engines and with other customers when aluminum housing was used.
3. Caterpillar knew that aluminum housing had a flaw that could cause failure such as those observed at Trans-Spec.
4. Caterpillar knew that changing the material of the housing to cast iron solved the problem in at least one case.
5. The design of the flywheel housing rendered the engine defective.
6. I have seen no basis that was offered by Caterpillar for rejecting Trans-Spec's warranty claims.
7. Caterpillar was obligated under the warranty to repair or replace defective engines and/or components. Alternatives that Caterpillar was aware of included the use of cast iron flywheel housings, the flywheel housing disclosed in the Caterpillar patent or the use of a metal plate under the bolt

heads as disclosed in Exhibit 12 of the Bowes Deposition. Caterpillar did not fulfill its obligations.

8. Rather than fulfill warranty obligations, Caterpillar instead performed inadequate tests that did not demonstrate the cause of the failure of its flywheel housings nor justified the denial of warranty claims.

6. Documents referred to or used:

Patent 6,065,757 and File Wrapper (attached)

Stewart and Stevenson information (attached)

Bowes and Colmer Depositions and Exhibits

Caterpillar-produced documents Bates numbered 1-4014

Caterpillar's Answers to Interrogatories and all attached exhibits

All documents produced by Trans-Spec to Caterpillar except for those maintained in a storage trailer at Trans-Spec's facility

Photographs taken of flywheel housings located at Caterpillar

Final Invoice/spec sheet produced by Minuteman Trucks, Inc. (attached)

7. List of Publications

See attached c.v.

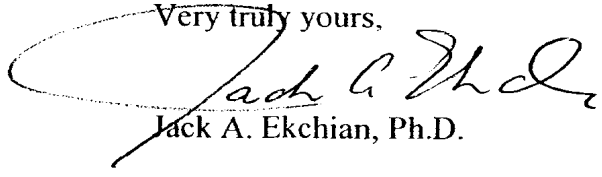
8. List of Cases in which I have testified as an expert at trial of by deposition

See attached c.v.

9. Compensation

$ 300/hour.

Very truly yours,



Jack A. Ekchian, Ph.D.